Executive Summary

Introduction

The City of Lincoln (City) and the Lower Platte South Natural Resources District (NRD) are in the process of developing a *Comprehensive Watershed Management Plan for the City of Lincoln* and its future growth areas. This comprehensive watershed plan is being developed basin by basin, through the completion of watershed master plans for individual basins. Watershed master plans are used as planning tools to be referenced in conjunction with future development and to serve as a guide in the preparation of capital improvement projects (CIPs).

The Cardwell Branch watershed planning process was conducted using a two-phased approach. Phase 1, called the Cardwell Branch Watershed Assessment was completed by the United States Geological Survey (USGS). The USGS report provided the foundation for Phase 2, called the Cardwell Branch Watershed Master Plan (Master Plan). The Cardwell Branch Master Plan is summarized in this report, together with the study components that served as its foundation.

The Cardwell Branch Watershed is located within and immediately southwest of the City's existing municipal limits (Figure ES-1). The Master Plan study area included areas downstream of Yankee Hill Lake, as well as areas draining to the south tributary. The study area, as shown on Figure ES, includes about 7.7 square miles of the approximately 16.3-square-mile watershed.

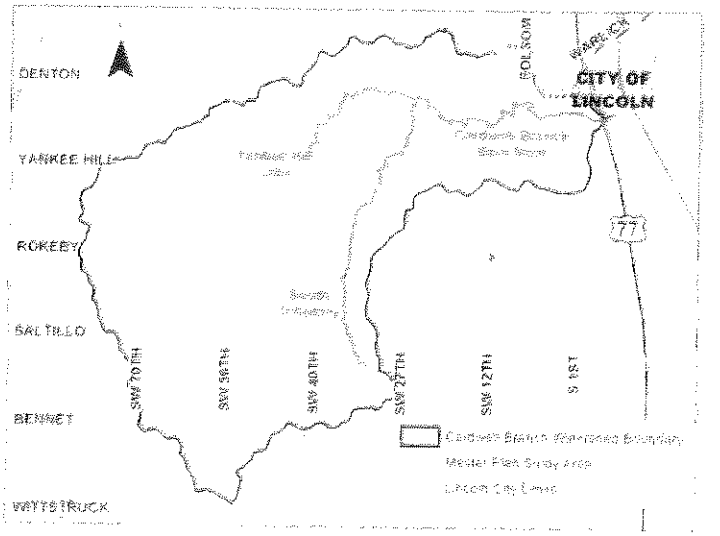


Figure ES-1
Cardwell Branch Study Area Map

The Master Plan has been prepared because future growth within the basin is expected, as identified in the Lincoln-Lancaster County Comprehensive Plan. The purpose of the Master Plan is to identify needed CIPs for flood management, water quality, and stream stability. The City and NRD have previously adopted watershed master plans for the Beal Slough, Southeast Upper Salt Creek, and Stevens Creek basins (Figure ES-2).

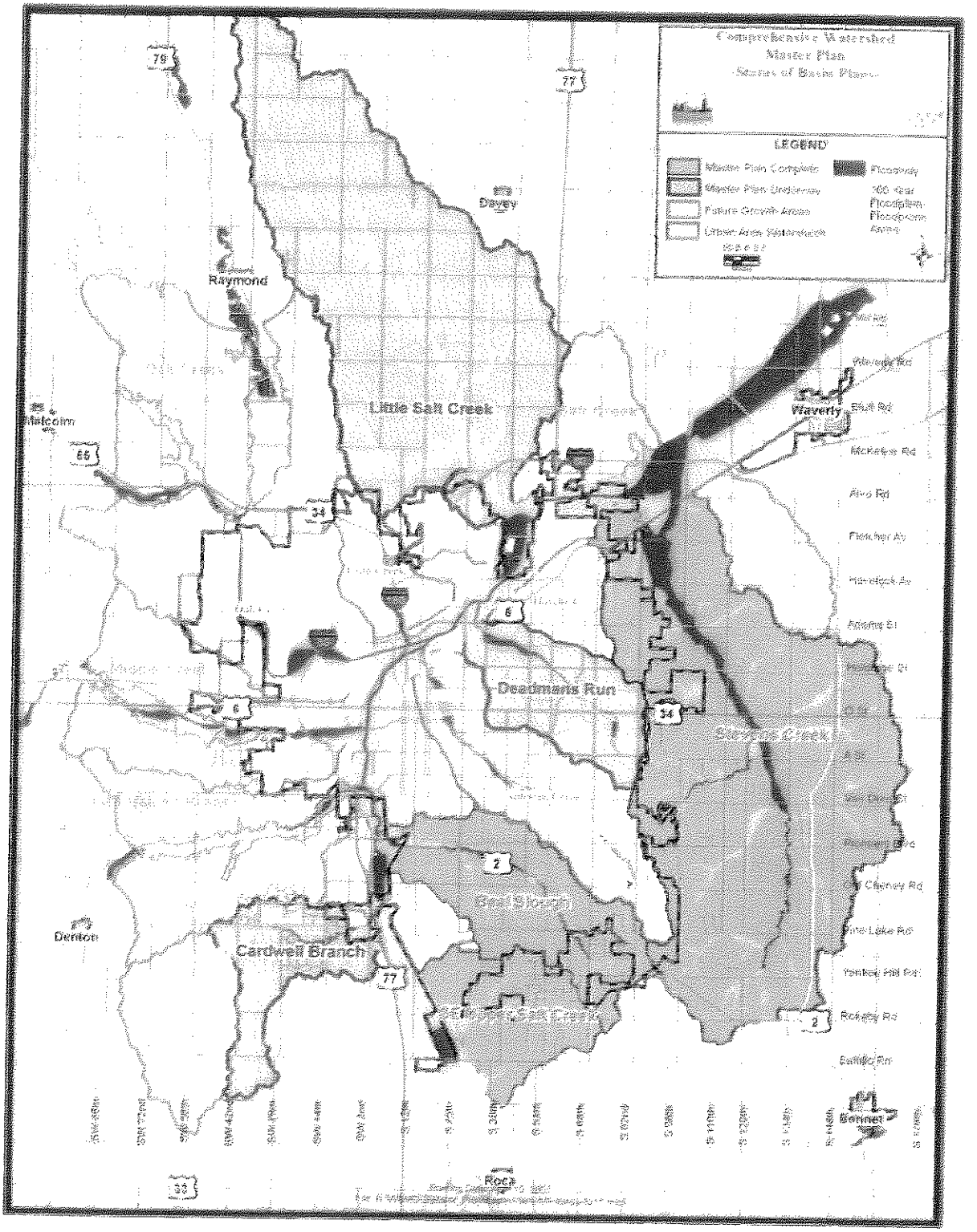


Figure ES-2
City of Lincoln Comprehensive Watershed Management Plan

The project team was led by the City and NRD, in cooperation with Lancaster County (County). The City and NRD retained the consultant team of Camp Dresser & McKee Inc. (CDM), in association with Mead & Hunt (M&H), Applied Ecological Services (AES), and Heartland Center for Leadership Development (HC), to provide assistance with the planning effort.

Public Participation Process

As part of the Master Plan development, a public participation process was used to solicit input from area residents and other interested parties. The public participation process included the following:

- Two open houses in October 2006 and August 2007
- A project website to post preliminary results and upcoming events
- A series of three newsletters mailed to over 600 individuals and organizations
- A series of 3 meetings with landowners regarding alternative management approaches

The public input and feedback received during this process was used by the project team to formulate and refine its master plan recommendations. Section 1 of the Master Plan provides further details regarding the public participation process.

Master Plan Elements

The Master Plan consists of four major elements: (1) Stream Buffer Protection and Restoration, (2) Stormwater Management Practices, (3) Opportunity Area Locations, and (4) Capital Improvement Projects. A brief summary of each major element follows:

Stream Buffer Protection and Restoration

One of the key observations during the Master Plan development was the loss of stream riparian habitat. The City's floodplain standards for new growth areas include a minimum flood corridor that provides a setback distance from the stream that must be preserved in its natural condition. This would include streams draining 150 acres or more and streams draining less than 150 acres with a defined bed and bank. For the Cardwell Branch stream reaches within the City's 3-mile jurisdiction, it is critical that this ordinance be strictly enforced to preserve the existing medium and high quality woodland riparian habitat as discussed in Section 3 of this report. Outside of the City's 3-mile jurisdiction where this ordinance does not apply, preserving a buffer equivalent to the minimum flood corridor setback distance is still important to provide the opportunity to restore the riparian corridor, which will help reduce runoff, enhance water quality, and improve habitat.

High quality riparian woodland vegetation downstream of SW 12th Street

The minimum flood corridor also offers an excellent avenue for future trail systems. As shown on Figure ES-3, the City's planned trail system alignment follows the Cardwell Branch main stem with the goal of connecting to the Yankee Hill Wildlife Management Area (WMA). The City's planned trail system located east of the watershed could be connected to other features within the watershed by extending the trail system directly west across the Cardwell Branch watershed to the proposed opportunity area, portions of the south tributary, and eventually to the Yankee Hill WMA as shown on Figure ES-3.

Other recommended stream buffer protection measures include vegetative maintenance and restoration efforts to enhance wildlife habitat, improve water quality, and provide stream stability. The vegetative maintenance and restoration efforts would vary depending on the specific reach in question, but could include thinning of the understory, selected application of herbicide on undesirable species, and replanting with native riparian species.

Stormwater Management Practices

As the Cardwell Branch watershed continues to develop, the key to preserving water quality, maintaining long-term stream stability, and providing flood control benefits for new developments is to install stormwater facilities that control the full range of hydrologic conditions, including the smaller rainstorms and the 2-, 10-, 100-year storm events. Site-specific structural best management practices (BMPs) are recommended to control the smaller rainstorms, with detention basins being used to control the larger rainstorms (2-, 10-, and 100-year design storms). Two implementation approaches are recommended to control the full range of hydrologic conditions, including (1) integrated detention facility, and (2) alternative site design. The paragraphs below describe each approach, followed by a discussion of sensitive areas within the watershed.

Integrated Detention Facility

The integrated detention facility approach is based on upgrading the standards for privately owned and operated detention ponds on each individual development site. The detention ponds would be designed to control not only the 2-, 10-, and 100-year storm events (current City standards) but also to include a structural BMP to provide long-term stream stability and pollutant removal benefits. This integrated facility would provide both quantity and quality benefits. This will require changing the City's stormwater ordinances and *Drainage Criteria Manual* from a voluntary to mandatory program for site-specific structural BMPs, which will result in significantly increasing the protection of natural streams and supporting federal stormwater requirements.

Alternative Site Design

The alternative site design approach allows the site designer to separate the site-specific structural BMP from the detention pond to achieve the same overall goals and objectives. The structural BMP can be designed to take many different forms including grass swales, bioretention filters, infiltration devices, and constructed wetlands. The site designer has the flexibility of selecting which type of structural BMP best fits the development site layout. The structural BMPs can be easily configured to become an integral part of the development site by supplementing landscape features, park amenities, and passive recreation amenities.

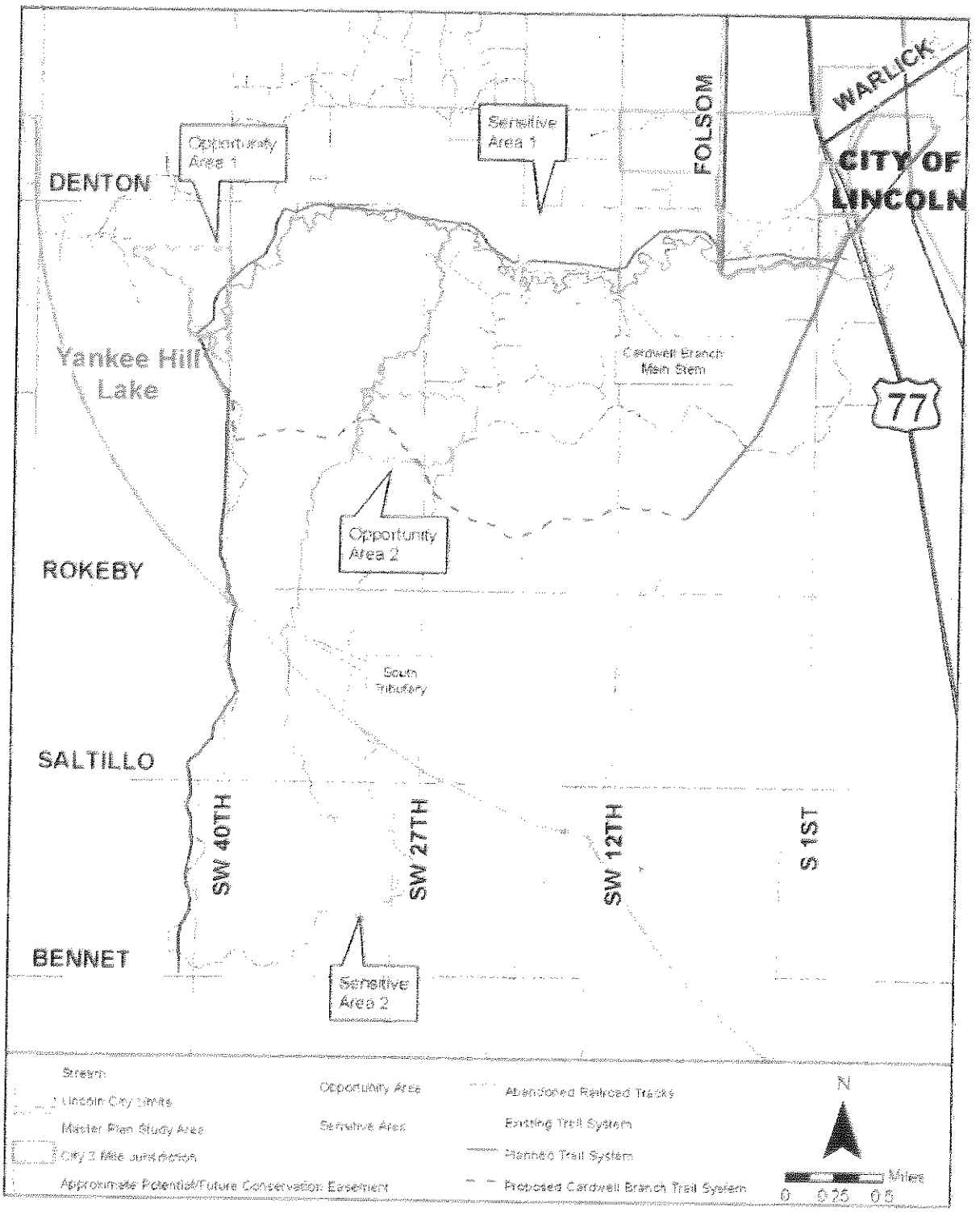
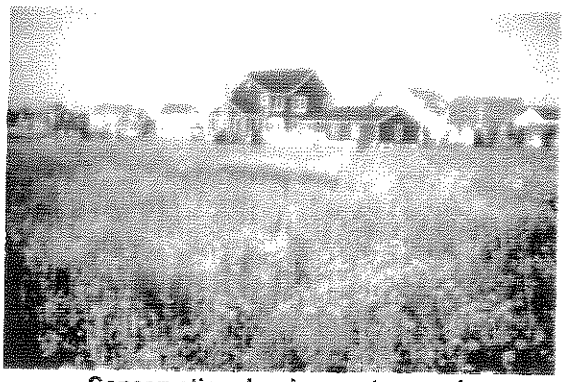


Figure ES-3
Cardwell Branch Watershed Management Recommendations

Another alternative site design approach is to use conservation development practices or low impact development (LID) techniques, which focus on using natural site characteristics to manage and reduce stormwater runoff. A common conservation strategy is to use clustered housing to preserve undeveloped natural areas to maximize green space. Strategies may also involve less clustered housing but incorporate native soils and vegetation on private lots to reduce stormwater runoff volumes and maximize infiltration. On private streets, consideration can be given to narrowing pavement width and reducing or eliminating curbs and gutters, particularly adjacent to waterways. Using these techniques reduces the amount of impervious surfaces, which in turn reduces stormwater runoff. Parkland dedicated with new developments can also be compatible with this approach, especially when native landscaping or other water quality plantings are incorporated. The development costs to implement LID practices have been shown to be lower than conventional development, and land values are typically higher because of the desirability of the community.



Conservation development example

When implementing alternative site design strategies, the design criteria needs to be consistent with the integrated facility approach, including controlling the smaller rain storms and the 2-, 10-, and 100-year design storms. In addition, similar to the integrated detention facility approach, requiring conservation development and/or structural BMPs would require changing the City's stormwater ordinances and *Drainage Criteria Manual* from a voluntary to mandatory program for requiring practices to address water quality.

Sensitive Areas

Sensitive areas are defined as general planning locations within the watershed that contain natural and/or unique characteristics that should be given the highest priority for implementing structural BMPs and conservation strategies for protection of natural resources. This could also include strategies like transfer of development rights if available as a zoning tool in the future. During the Master Plan development, two sensitive areas within the study area were identified as shown on Figure ES-3 and described below:

Sensitive Area 1

This area lies along the main stem of Cardwell Branch between South 1st Street and SW 27th Street and contains floodplain, riparian stream corridor, medium to high quality woodland habitat, potential/future conservation easements, and a future trail. This area is within the Tier 1 growth area for the City of Lincoln. To protect these high value natural resources, surrounding development sites need to be encouraged to use structural BMPs and conservation strategies to protect this riparian corridor.

Sensitive Area 2

This area includes the headwaters of the south tributary, located south of Saltillo Road and between SW 40th Street and SW 27th Street. The protection of the headwaters is particularly important, due to the rolling, steep topography in this area and because any increase in stormwater runoff at this location could exacerbate stream instability and water quality degradation further downstream. This sensitive area is zoned AG Agriculture, and it is currently outside of the City's 3-mile jurisdiction. Thus, neither the City's Minimum Flood Corridor (stream buffer protection) standard, nor the stormwater management practices described above (if adopted) would apply in this location. For the time being, the existing vegetative buffers should be conserved and enhanced. Consideration should be given to protection of stream buffers and addressing stormwater runoff if special uses permitted in the Agriculture district are proposed which would have the potential to impact this area and the downstream area.

Opportunity Area Locations

Opportunity areas are general planning locations within the watershed where landscape features provide an opportunity to have a positive impact on water resources while realizing other goals. This approach recognizes that floodplains, tributaries and upland areas are all part of a comprehensive integrated watershed system. The Comprehensive Plan includes strategies for seeking "Rain to Recreation" project approaches that reduce flood damages, protect water quality and natural areas, while providing for recreational and educational opportunities so as to realize multiple benefits. To this end, the Master Plan has identified areas with the potential for multiple benefits such as enhancing water quality, protecting natural resources, and incorporating future amenities like parks, trails, and playing fields. These areas are generally identified on Figure ES-3. Due to these characteristics, it is recommended that these areas be designated as Green Space on the City/County Land Use Plan. Consideration should be given to future projects in these areas that protect, enhance and provide opportunities for multiple benefits through voluntary conservation easements or land acquisition, and/or water quality enhancements through native vegetation restoration. These sites would also be good candidates for using transfer of development rights if available as a zoning tool in the future.

Opportunity Area 1

This area is located at the base of Yankee Hill dam, adjacent to the Yankee Hill WMA, and provides an opportunity to reduce stormwater runoff and enhance water quality while providing for recreational opportunities. The area also includes the riparian corridor along Cardwell Branch that drains from the dam and a portion of the spillway. Key areas of the existing cropland and smooth brome fields could be converted to native tall grass prairie, thus enhancing runoff infiltration capacities and water quality benefits. The exact location and extent of native prairie grass plantings within this planning area would need to be carefully considered with the goal of protecting the integrity of the dam. Passive recreation areas with native vegetation could be coupled with active recreation areas (playing fields), to provide an optimal use of land that is located immediately downstream from an existing lake dam.

Opportunity Area 2

This area is south and west of SW 27th and W. Denton Road. It includes the main stem of the south tributary, the confluence with a secondary tributary flowing from the southeast,

riparian corridors, native tall-grass prairie, and a future trail. In addition, the Master Plan identifies a stream stability capital improvement project in this location and examines the potential for a regional detention basin for flood control. There are opportunities to enhance the vegetation for water quality and wildlife, to consider future east-west trail connections, and to complete "Rain to Recreation" projects that provide multiple benefits. While this area is in the City's Tier II growth area, consideration should be given to amending the Future Parks map to identify a Neighborhood or Community Park once inside Tier 1.

Capital Improvement Projects

The process of formulating CIPs required the identification of primary and secondary problem areas in relation to the public interest. Primary problems are those that pose a public safety concern with respect to frequent building flooding (2- and 5-year design storms) that is typically caused by an altered drainage system, stream instability, or severe maintenance conditions. In addition, primary problem areas include sites where stream degradation or instability exist, which creates a clear influence elsewhere in the watershed.

Secondary problems include sites where stream degradation or instability exist but are not likely to propagate to other areas of the watershed. Secondary problems also include infrequent flooding of habitable buildings (10-, 50-, and 100-year design storms) if the problem is being caused by a deficient altered drainage system. Habitable buildings located in the natural 100- and 500-year floodplain are not considered primary or secondary problem areas. However, under unique circumstances, buildings located within the natural floodplain could be considered a secondary problem. Secondary problems are not considered as serious as primary problems and should be addressed in conjunction with other infrastructure projects occurring in the watershed. For example, many secondary problems can be addressed at the same time roadways are improved and water and wastewater pipelines are installed if they are located in the same general vicinity. In addition, secondary problems can be combined with routine maintenance activities. Secondary problems could also be addressed as a private project; however, close coordination with the City, County, and NRD would be required.

The Master Plan includes nine CIPs to address the primary problem areas identified in the watershed. In this watershed, eight stream instability problems and one flooding problem meet the criteria for primary classification. Figure ES-4 shows the approximate location of each project. Projects CB-1 through CB-8 address stream instability problems, while CB-9 addresses a localized flooding problem. The total capital cost for all nine CIPs is estimated to be approximately $3.2 million; however, this does not include costs for easements or land rights. Section 5 of the Master Plan provides further detail regarding the classification process and conceptual capital improvements to address the primary problem areas.

The prioritization of Cardwell Branch CIPs was completed according to the prioritization system that was developed for the City and NRD by a peer review committee to set priorities for the implementation of watershed master planning projects. The peer review committee consisted of local consultants along with City, State, and NRD staff who provided input and guidance regarding the prioritization criteria and appropriate

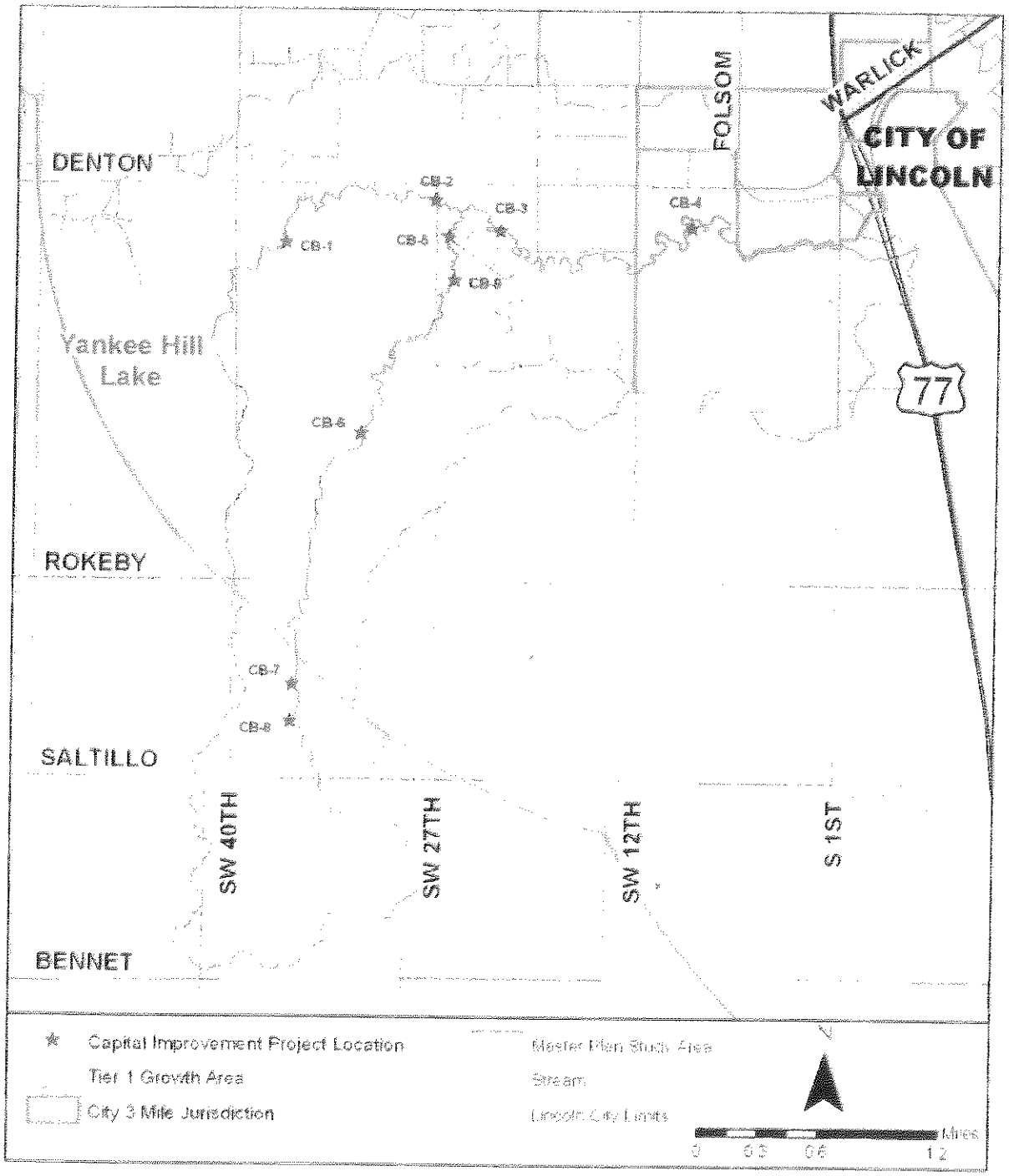


Figure ES-4
Cardwell Branch CIP Locations

weighting of the selected criteria. The prioritization system was specifically developed for CIPs that are part of the ongoing watershed master planning efforts.

The prioritization system contains five major categories including flooding impacts, stream stability, water quality, safety factor, and miscellaneous factors. For each project, a ranking worksheet is used to assign points under each category, with the goal of developing an overall score. The projects with the highest point score are considered a higher priority. Table ES-1 lists the results of the ranking scores for the nine CIPs within the Cardwell Branch study area. For projects with the same overall score, engineering judgment was used to finalize the ranking.

Table ES-1
Cardwell Branch Priority Ranking Results

Project No.	Overall Score	Project Ranking	Project Cost
CB-1	170	9	$228,900
CB-2	205	2	$349,300
CB-3	190	5	$275,500
CB-4	205	3	$703,600
CB-5	205	4	$237,300
CB-6	190	6	$890,100
CB-7	185	7	$216,300
CB-8	185	8	$226,600
CB-9	245	1	$45,200
		Total	$3,172,800

As implementation begins on the Cardwell Branch CIPs, the priority of these projects will need to be reviewed and weighted against other projects included in adopted watershed master plans.

Summary

The Cardwell Branch Watershed Master Plan provides the necessary planning tools and CIPs to address flood management (updated Federal Emergency Management Agency [FEMA] Maps - Phase 1 planning effort), water quality, and stream stability for achieving sustainable urban growth in the watershed. The City, County, and NRD should use this master plan as a reference and guide for the implementation of improvement projects in the Cardwell Branch Watershed through the City and County Capital Improvement Programs and NRD's Long Range Implementation Plan. The agencies should use cooperative efforts to address project timing, prioritization between basins, and the sharing of responsibility.

By using the detailed study information and applying the Master Plan elements described above, multiple goals will be achieved including:

- Protection of future homes and businesses from flood hazards
- Reduction of future impacts to water quality and stream stability due to urbanization
- Preservation of aquatic and riparian habitat
- Long-term stream stability that protects public infrastructure
- Development guidelines that address stormwater quantity and quality
- Opportunities for multiple benefits through an integrated approach to watershed planning
- Compliance with City, State, and Federal regulatory requirements to protect and preserve water quality